

ABSTRACTS OF PODIUM AND POSTER PRESENTATIONS

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Morphometric analysis of craniofacial shape and growth patterns in *Australopithecus africanus*. R.R. ACKERMANN¹ and G.E. KROVITZ². ¹Dept. of Anatomy & Neurobiology., Washington University, St. Louis, MO 63110. ²Dept of Anthropology, George Washington University, Washington DC 20052.

Since its initial discovery in 1924, the Taung skull has held a central – if sometimes controversial – position in hominid evolutionary studies. Although recent histological studies and CT analyses have suggested that an ape-like pattern of dental development is most appropriate for Taung, it is less clear whether an ape-like pattern of craniofacial growth is similarly appropriate for this fossil hominid.

In this study, Euclidean Distance Matrix Analysis (EDMA) is used to examine craniofacial shape and growth patterns in *A. africanus*. 3-D coordinate data were collected from 7 landmarks on the face and palate of the original Taung and Sts 5 (Mrs. Ples) fossils and from comparative samples of juvenile and adult modern humans (N=21_{Juv}, 141_{Ad}), gorillas (N=11_{Juv}, 115_{Ad}), common chimps (N=13_{Juv}, 65_{Ad}) and bonobos (N=27_{Juv}, 23_{Ad}). Juvenile individuals were selected if M1 was the only erupted permanent tooth, as seen in Taung. Shape difference and growth difference analyses were carried out. Additionally, hypothetical adult forms were created by “growing” Taung according to living hominoid growth trajectories, and then compared to Sts 5.

Taung and Sts 5 display a mosaic of traits when compared to living hominoids, and shape and growth analyses reveal features that are similar to both apes and humans. The overall size of Taung is close to that of juvenile bonobos, while the size of Sts 5 is close to that of common chimp adults. Within extant species, ontogenetic size differences of this magnitude are only seen in gorillas. However, in spite of the age and size differences between Taung and Sts 5, these two individuals exhibit similar aspects of shape that are not found in living apes and humans. The shape of the *A. africanus* maxilla is distinctive, particularly in the relationship between the zygomatic and post-canine alveolar regions. Growth analysis confirms a unique growth pattern for this morphological region. “Growing” Taung into other hominoids further illuminates these patterns, and offers

insight into the relationship between the two early australopithecines.

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Dental caries in prehistoric California Indians: A comparative test of the Jomon agriculture hypothesis. A.J. ADLER and C.G. TURNER II, Dept. of Anthropology, Arizona State University, Tempe 85287-2402.

In 1979 Turner suggested that the relatively high caries rate in crania from shellmound accumulations in central Japan left by terrestrial and aquatic hunting-and-gathering Jomonese might have been due to some form of agriculture involving plants such as taro since the Jomonese caries rate matched that found in known agricultural populations elsewhere in the world. Years later, he made observations on more Jomonese and three prehistoric California Indian skeletal assemblages to test the Jomon caries hypothesis.

These included low, moderate, and high acorn usage groups from north coast Humboldt, Alameda bay area, and the Sacramento interior valley. It was felt that the strongly maritime Humboldt shell midden crania would have lower caries than the Jomonese, the Alameda crania should have more than Humboldt, but less than Jomon, and the Sacramento teeth should have less than Jomon, but more than Alameda.

The raw California and additional Jomon

observations were recently analyzed by Adler who found that these expectations generally held. However, caries in the Sacramento series were higher than expected, exceeding that of the Jomonese in various tabulations. Midden refuse and ethnographic reports clearly show the marked dependency on wild seeds and nuts by the California Indians, whereas food refuse in the Jomonese middens shows heavy dependence on aquatic and terrestrial animal products, similar to that of Alameda. Whatever the types of caries-causing carbohydrates (nuts, tubers, fruits) consumed by the Jomonese, their cariogenicity must be greater than that in the Sacramento diet. This analysis does not overthrow the Jomon agriculture hypothesis, nor is it as supportive as anticipated. More needs to be learned about Jomonese food sources and their processing.

Differences between medieval and modern trabecular bone architecture. S.C. AGARWAL^{1,3}, M. DUMITRIU³, and M.D. GRYNPAS^{2,3}, Department of Anthropology¹, Department of Laboratory Medicine and Pathobiology², U of Toronto, Samuel Lunenfeld Research Institute of Mount Sinai Hospital³.

Osteoporosis is a growing health concern in the aging population. It is characterized by a decrease in bone mass and a change in bone quality, and is clinically recognized as an increased rate of fracture due to bone fragility. In an attempt to better understand the patterns and prevalence of the disease, there has been a steady interest in the paleopathology of osteoporosis. However the majority of paleopathological studies concentrate on loss of bone mass, and only few address the important role of bone quality in osteoporosis.

In order to examine age and sex-related changes in bone quality in the past as compared to modern populations, a study was made of trabecular bone architecture in a British medieval skeletal sample. X-ray images of 5mm thick coronal lumbar vertebral bone sections were taken from a total of 55 adult individuals (m=24, f=31) divided into three age categories (18-29, 30-49, 50+ yrs). X-ray films were scanned into a Quantimet 570 (Leica) image processing and analysis system to evaluate trabecular bone structure and connectivity. A significant age-related loss of trabecular bone volume (TBV %), and trabecular number (Tb.N) was found between the youngest and the two older age groups. Anisotropic ratio, 2-D star marrow volume, and strut analysis also demonstrated an age-related loss of connectivity between the youngest and the two older age groups. Age-related loss of structure and connectivity appears to be greater in males than females. These patterns contrast with those shown in modern populations that exhibit significant loss between middle and old age, and where the greatest losses occur in females. We speculate that the loss between the youngest and the older age groups may be related to nutritional deficiency, while "lifestyle" factors such as physical activity, parity and prolonged periods of lactation may explain the low prevalence of fragility fracture and maintenance of bone connectivity in the oldest

age groups. The study of qualitative elements such as trabecular architecture is vital if we are to fully understand the natural history of osteoporosis.

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Neandertal frontals from Croatia: new reconstructions and new specimens. J.C.M. AHERN, Department of Anthropology, University of North Dakota, Grand Forks, ND 58202-8374.

The Hrvatsko Zagorje region of Croatia has yielded numerous, important paleolithic finds. Most prominent among these are the Neandertal fossils from Krapina Rockshelter and Vindija Cave. These fossils have proven to be a rich source of data for testing hypotheses about Neandertal evolution, adaptation, and behavior.

This study reports on four new, fragmentary cranial specimens and two newly reconstructed anterior cranial vaults. The four new cranial fragments all derive from Vindija Cave. Two of these are small *stephanion* fragments. Another is a piece of anteroinferior parietal with adjoining pieces of frontal and temporal. The fourth specimen is a frontal fragment preserving a portion of coronal suture.

Of the two newly reconstructed cranial vault specimens, one comprises fossils from Krapina level 4, while the other consists of fossils from Vindija level G₃. The Krapina 27/28 reconstruction is an association of a robust right lateral supraorbital torus with a large portion of central frontal squama and posterior frontal sinus wall. The link between these two specimens was made with Dr. T.D. White's discovery of a conjoining specimen in the Krapina faunal remains. The newly reconstructed and associated Vindija anterior cranial vault, Vi 230/255/256/284, comprises a right lateral segment of gracile supraorbital torus, a large portion of frontal squama and posterior sinus wall, and a portion of anterior left parietal. These articulated fossils form the best preserved cranial specimen from Vindija Cave.

The newly reconstructed Krapina and Vindija specimens differ significantly. The Vindija specimen combines a gracile lateral supraorbital with thick frontal squama and a large frontal sinus. Kr 27/28 combines a robust supraorbital torus with a comparatively thin and gracile frontal squama. These differences are discussed in the context of the systematic differences between the earlier Krapina hominids and the later Vindija Neandertals.

Mediolateral loading patterns across the knee joint in catarrhine primates. K. AHLUWALIA, D.P.A.S., SUNY at Stony Brook, NY 11794.

It has been shown that the mediolateral distribution of loads across the knee in humans is primarily dependent on the

adduction/abduction moment at this joint (Schipplein *et al.*, 1991). In turn, the adduction/abduction moment at the knee joint is dependent on both the mediolateral direction of the substrate reaction force and the position of the center of the knee joint in relation to the SRF.

Force plate studies have shown that the substrate reaction force has a medially directed component in terrestrial primates, but a laterally directed component in the arboreal species (Schmitt, 1995). Examination of the posterior view of primates locomoting reveals that humans and terrestrial quadrupedal monkeys have almost vertical tibiae, while knuckle-walkers and arboreal monkeys have highly inverted tibiae. This suggests that the adduction moment at the knee is greatest in the knuckle-walkers. Terrestrial quadrupeds and bipeds should also experience an adduction moment. Arboreal quadrupeds may be subjecting their knees to an abduction moment.

The bony morphology of the knee joint was examined to see if it reflected these differences in mediolateral load distribution across the knee. Gross morphological measurements were taken on the hindlimbs of several catarrhines species with differing locomotor behaviors. These measurements were chosen for their ability to reflect femoral and tibial articular surface shape in the knee. Contour maps of subchondral cortical bone density in the proximal tibia were created from contiguous series of density calibrated CT images taken perpendicular to the joint surfaces. The region of maximum density, calculated from these maps, corresponds to the point of maximum loading (Müller-Gerbl *et al.*, 1989, 1992).

Discriminant analyses of the articular surface data reveal that species form non-overlapping groups according to locomotor behavior in both the hominoids (bipeds, knuckle-walkers, suspensory primates) and the Old World Monkeys (terrestrial quadrupeds, both leaping and non-leaping arboreal quadrupeds). Although the bone density patterns do not discriminate as well between locomotor categories, a trend can be discerned. Knuckle-walkers have the greatest mediolateral discrepancy in density patterns with the regions of maximum density covering a much larger percentage of area on the medial plateau. This mediolateral discrepancy in density tends to decrease with increasing arboreality. In some leaping arboreal quadrupeds the region of high density on the lateral plateau covers a greater percentage of total articular surface area than the same region on the medial plateau.

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High-throughput genotyping of Y-chromosome SNPs by fluorescence monitoring of product melting curves.

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Y-chromosome markers are often used as a powerful means of delineating patterns of male migration in population genetic studies. Here, we investigate the feasibility of genotyping Y-chromosome SNPs by analyzing amplicon melting curves using real time fluorescence monitoring. Specifically, melting curves were acquired by using a fluorescence detecting thermocycler and the dye SYBR Green I, which fluoresces only when bound to double stranded DNA. Moreover, we found the addition of formamide to PCR products enhanced resolution of melting temperature (T_m) between alleles and reduced background fluorescence attributable to primer dimer formation. The T_m of 48 individuals who had

previously been genotyped at locus M122 (C/T substitution) by allele specific PCR was determined. The average T_m of amplicons containing C and T alleles were 72.4°C and 71.3°C, respectively while the standard deviation was only 0.4°C. Hence, there is adequate sensitivity for distinguishing alleles at the M122 locus, and we anticipate this method can be easily extended to other Y-chromosome SNPs. As 96 samples can be analyzed in 20 minutes following the initial PCR, this assay represents a high-throughput low cost approach to genotyping Y-chromosome SNPs. (Research supported by a grant from Li Foundation).

Taphonomic processes or mortuary preparation: insights from New Mexico assemblages. N. J. AKINS. Office of Archaeological Studies, Museum of New Mexico, Santa Fe, NM 87501

Events of the past few years have made human osteologists more aware of the taphonomic conditions and mortuary practices that affect human bones as well as the necessity of examining and evaluating all possible explanations. Human remains recovered from archaeological sites rarely represent a single event. Yet, complexity is masked when archaeologists or physical anthropologists apply the same interpretation to an entire assemblage.

This complexity is well illustrated in three burial and disarticulated assemblages recovered from northwestern, north central, and southeastern New Mexico. While a superficial review could conclude that most, if not all, of the assemblages result from malevolent human behavior, taphonomic processes and mortuary treatment provide alternative explanations for at least some of the variability. Each individual or bone should be examined with respect to mortuary treatment and taphonomy. This includes examining the conditions of deposition, considering the range of potential causes for various breaks and marks, understanding the implications of different kinds and intensities of burning, comparing human and animal bone from the same context, and many other perspectives. A multifaceted approach suggests that complex treatment and taphonomic effects can explain a great deal of the observed variability in these three human assemblages.

A comparison of bilateral asymmetry in skeletal maturation between upper body and lower body epiphyses. A.M. ALBERT, Department of Sociology, Anthropology, and Criminal Justice, UNC Wilmington, NC 28403-3297

Bilateral asymmetry in skeletal maturation was recently studied as an indicator of environmental stress in two cemetery samples of Kulubnarti Nubians (550-1450 AD) (Albert, 1999). It was suggested that the significant differences found for the progress of union between right-side and left-side epiphyses resulted from environmental stress (e.g. nutritional deficiencies) as opposed to biomechanical stress (Albert and Greene, forthcoming).

The purpose of this study is to further examine the likelihood that environmental perturbations, as opposed to biomechanic factors, lead to bilateral asymmetry in epiphyseal union. It is hypothesized that right-side and left-side epiphyseal union does not significantly differ between upper body and lower body bones, given the assumption that environmental stress and not biomechanic factors result in bilateral asymmetry in skeletal maturation. The same two cemetery samples from the previous study on bilateral asymmetry in Kulubnarti Nubians are used in this study (N=90, ages 11 to 31 years). Mean values are computed for the stages and progress of union of epiphyses of the right and left sides of the upper and lower body. These mean values are tested for significant differences.

Results of paired samples t-tests show no significant differences in bilateral asymmetry in skeletal maturation between upper body and lower body epiphyses ($p < .538$, $p < .718$). The lack of differences in this study suggests that bilateral asymmetry does not manifest differently in the upper body from the lower body. While the possibility exists that bilateral asymmetry could result from right-hand dominance-related biomechanic use, this study establishes that upper body versus lower body biomechanic factors can be ruled out as a possible cause of bilateral asymmetry in the Kulubnarti Nubians.

Multivariate morphometric patterns of sexual dimorphism in primates. G.H. ALBRECHT, University of Southern California, Los Angeles, CA 90033.

Primates display a range of sexual differences in many aspects of their biology besides reproductive characteristics (e.g., body size, coloration, dentition, social behavior, and feeding). Such sexual differences have been attributed to a variety of causative factors (e.g., social structure, ecology, and ontogenetic patterns). Charles Oxnard (1983, 1985, 1987) demonstrated that morphological differences between males and females of different primate species are equally multifaceted. However, most comparative studies of primate sexual dimorphism continue to rely on univariate analyses. Typically, for some measured dimension X , the relative difference between males and females is expressed as a ratio (e.g., most simply, $X_{\text{male}}/X_{\text{female}}$).

Given that sexual dimorphism is not a unidimensional phenomenon, multivariate morphometric analyses are required to characterize the complex nature of sexual variation that exists in primates. A prerequisite to interpreting the results of such multivariate studies is an understanding of how the sexes may possibly differ from one another from species to species when plotted in the multivariate data space. Male and female samples of one species may differ from those of another species in the following ways, each of which has specific implications for interpreting patterns of sexual dimorphism. The distance between male and female group centroids may vary (i.e., species exhibit differences in the overall magnitude of sexual dimorphism). The orientation of the line joining male and female group centroids may vary (i.e., species exhibit shape-related differences in sexual dimorphism). The size and shape of the within-sex

dispersion of points may differ in males versus females (i.e., species exhibit sex-related differences in variability). The orientation of the within-sex dispersion may differ between the sexes (i.e., species exhibit different patterns of shape variation in males versus females). The orientation of the major within-sex axes differs from the line joining male and female group centroids (i.e., species exhibit different patterns of shape variation within versus between the sexes). Finally, although not morphological in nature, the sample sizes for males and females may vary (i.e., species exhibit different sex ratios).

The different kinds of dimorphisms outlined above are illustrated using craniometric samples of monkeys, apes (data from Colin Groves), and humans (data from W.W. Howells). These examples reinforce Professor Oxnard's observations about the multifaceted, multifactorial nature of sexual dimorphism in primates.

Brain morphology, MRI data, and landmark-based analyses of form. K. ALDRIDGE, P.E. BARTA, G.D. PEARLSON, and J.T. RICHTSMEIER, Johns Hopkins University School of Medicine, Baltimore, MD 21205.

Traditional studies of the evolution of the human brain have been based on comparative analyses of external neuroanatomical features through the use of endocasts or preserved specimens of human and non-human primates. Recent technological advances have allowed scientists to study the brain *in vivo* through the use of magnetic resonance imaging (MRI). MRI allows a three-dimensional investigation of internal as well as external anatomy, making it possible to perform quantitative analyses of form. Landmark-based studies of form provide an invaluable addition to the types of information already available in quantitative and qualitative studies of neuroanatomy. However, before landmark methods may be utilized, an analysis of precision and repeatability of landmarks digitized from MRI data must be performed.

This study analyzed the precision and repeatability of 37 landmarks digitized from MRIs of the brains of 10 human individuals (5 males, 5 females). Landmarks were chosen from multiple regions, including the telencephalon, diencephalon, midbrain, and brainstem. Landmarks were digitized 10 times on each of the 10 individuals using 3D reconstructions as well as axial, coronal, and sagittal slices.

Our results indicate that strictly defined neuroanatomical landmarks can be digitized with high levels of precision and repeatability. Landmarks that had relatively low measures of precision also had relatively low measures of repeatability. These landmarks included terminations of cortical sulci and points on the lateral ventricles, indicating that cerebral features are more difficult to localize relative to landmarks found on other brain regions. These results show that landmark-based studies of brain morphology show great promise for elucidating spatial relationships between neurological structures, not only in humans, but in comparison to non-human samples.

The Health consequences of consanguineous marriage in Kuwait. Y. AL-KANDARI. Dept. of Sociology and Social Work, Kuwait University, PO Box 68168 Kifan, Postal Code 71962, Kuwait.

In Kuwait, as in most other Arabic and Muslim societies, consanguineous marriage is favored, as a result, the rate of consanguineous marriage in Kuwait is generally considered to be high. There are many cultural reasons for allowing someone to marry from among their relatives. Some research has proven that marriage among relatives is one of the major factors leading to health problems because it increases homozygosity. In other words, some diseases may appear as a result of an increase in the frequencies of homozygotes for certain rare recessive alleles.

The paper deals with both cultural and physical aspects by examining the health consequences of consanguineous marriages in Kuwait. Variables such as reproductive wastage, health problems in the offspring, and infant mortality are included and measured.

Female respondents from non-consanguineous marriages reported the lowest percentage of health problems in their children, a lower incidence of pregnancy losses, and the fewest deaths among their children. By contrast, female respondents from first and double cousin marriages reported the highest percentages of pregnancy losses, major health problems in their children, and more cases of child death. As there is variability among the three marriage types in these results, one-way ANOVA was used to determine which differences were significant. Results of these analyses show that only the differences in pregnancy losses were significant, with the females from non-consanguineous marriages showing significantly lower pregnancy losses than in the females from either first or double cousin marriages.

Gray-white volumes of the major lobes of the human cerebrum: An MRI study using an automated segmentation algorithm. J.S. ALLEN, Departments of Neurology and Anthropology, University of Iowa, UIHC, Iowa City, IA 52242; H. DAMASIO, T.J. GRABOWSKI, J. COLE, Department of Neurology, University of Iowa College of Medicine; R.J. FRANK, Lawrence Livermore National Laboratories.

The quantitative distribution of gray matter (primarily neuronal cell bodies) and white matter (myelinated axons) in the human brain is not well established. Recent MRI-based studies have provided gray-white (G/W) measurements over large sectors of the brain (hemispheres), or have been based on sampling methods over smaller and arbitrarily defined regions. No study has addressed G/W distribution in the anatomically defined basic sectors of the hemispheres.

We report on a study of the gray-white volumes in the major lobes and gyri of the human cerebrum. Regions of

interest were defined by identifying neuroanatomical surface landmarks on 3D volume reconstructions of T1-weighted contiguous MR coronal sections through the whole brain (1.5-1.6mm thick; typically 110-120 slices per brain). The following regions were manually traced separately for left and right hemispheres: frontal lobe, temporal lobe, parietal lobe, occipital lobe, cingulate gyrus, and the insula. The MRI data were segmented into gray-white-CSF using an automated algorithm, which was capable of generating fractionally classified voxels. This algorithm has been extensively validated against the performance of human experts. Subjects were 20 men and 20 women between the ages of 20 and 50 years. All were right-handed, healthy, and without neurological or psychiatric disease.

Preliminary analyses indicate that all major lobes were significantly larger in males than in females. There was a consistent trend for females to have higher G/W ratios than males. However, for individual lobes, the G/W ratio was not strongly correlated to volume. Cerebral asymmetries in G/W distribution were also found.

This study provides quantitative data on inter- and intraindividual variation in the distribution of the gray and white matter of the human brain. These data may indicate constraints on the extent of "reorganization" that may have occurred over the course of hominid brain evolution, and may also be useful in a clinical context.

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Comparing patterns of Y chromosome and mitochondrial DNA variation in the Hominoidea.

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Contrasting patterns of Y chromosome and mitochondrial DNA genetic variation in humans have been hypothesized to result from different male and female dispersal processes. In order to establish whether mtDNA and the Y chromosome exhibit congruent or contrasting patterns of variation in great apes we sequenced ~1400bp of the SRY region of the Y chromosome and 360bp of the mitochondrial 16S rRNA gene in *Gorilla gorilla*, *Pan paniscus*, *Pan troglodytes*, *Pongo pygmaeus*, as well as *Homo sapiens*.

Chimpanzees and orangutans had the highest levels of Y chromosome diversity, while bonobos and gorillas exhibited no variation. Although mitochondrial DNA levels of genetic diversity were higher than for the Y chromosome in orangutans, haplotype networks for both systems were geographically congruent. In contrast, preliminary mtDNA data for chimpanzees and gorillas suggest contrasting mtDNA and Y chromosome phylogeographic patterns. As there are several non-mutually exclusive evolutionary forces that can affect these patterns of variation, future work will investigate the interaction of mating systems, sex-specific migration behavior, and locus-specific factors (e.g. mutation and selection) in shaping observed maternally- and paternally-inherited variation in these species.

Cooperative big game hunting. M.S. ALVARD, State University of New York - Buffalo. Department of Anthropology, Buffalo, NY 14261

A hominid subsistence strategy that includes large game presents two important and related challenges. First, since large prey types are unavailable to individual foragers, individuals must cooperate to acquire the resource. Second, those involved in the acquisition must obtain a satisfactory payoff from the carcass to insure future cooperation.

The well-known game called Prisoner's Dilemma (PD) has dominated game theory research on cooperation because it presents challenging obstacles to cooperation while at the same time provides a good model for understanding reciprocity. While a good model of some types of reciprocity, the Prisoner's Dilemma is not the best paradigm for understanding all types of cooperation involved in large game hunting. Models of synergistic mutualism differ from the Prisoner's Dilemma in the relative payoffs for cooperators and defectors. Selection favors mutualism in circumstances where not cooperating inflicts a cost on the cheater. Mutualism more closely matches the payoffs common to cooperative big game hunting.

I present payoff data from an ongoing study of the cooperative hunting practices of traditional Indonesian whale hunters of the village of Lamalera, in the province of Nusa Tenggara Timur, Indonesia. The data were collected from October 1998 through August 1999. Hunts focus around ~11m vessels of traditional construction called *tena*. Oars and large rectangular woven palm sails propel these boats. Manned by crews of at least eight and up to 14 or more, killing large prey with a *tena* is a manifestly cooperative activity, impossible to accomplish alone. Prey are dispatched with ~6m long harpoons tipped with iron points. The primary prey are sperm whales (*Physeter catodon*) and ray (*Mantis birostris*, *Mobula kuhlii*, and *Mobula diabolus*). The common alternative to whaling is relatively non-cooperative hook-and-line or net fishing with small boats called *sapā*, accomplished alone or in teams of two.

The data support the hypothesis that cooperative big game hunting at Lamalera is mutualistic. Analysis from a sample of 802 whale hunts indicates that returns from cooperative whaling are greater than the alternative of *sapā* fishing. Cheating is costly. Noncooperative *sapā* fishing returns approximately 0.39kg per hour per person (N = 1021 fishing trips). Whaling returns 0.0kg per hour if attempted alone.

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Fiber architecture of the muscles of the shoulder and arm in semiterrestrial and arboreal guenons. F. ANAPOL, University of Wisconsin-Milwaukee, Milwaukee, WI 53201.

In this study of forelimb muscle morphology and primate locomotion, fiber architecture is examined in muscles of the shoulder and arm in the semiterrestrial vervets (*Cercopithecus aethiops*) and arboreal red-tailed monkeys (*C. ascanius*). Wet weights and lengths of whole muscles, lengths of fasciculi and their associated proximal and distal tendons, and angles of pinnation were measured in

deltoideus, infraspinatus, supraspinatus, subscapularis, teres major, and t. minor of the shoulder, and coracobrachialis, biceps brachii, brachialis, and triceps brachii of the arm. The measurements were used to estimate generally recognized morphological correlates of physiologic properties of muscle: force, velocity, and relative isometric or isotonic use of individual muscles.

Overall, the mean total-shoulder:total-arm ratios for muscle mass and reduced physiological cross-sectional area (RSPCA, an estimate of force output) are not significantly different ($p < 0.05$) between species. Generally, when expressed as a percentage of its group (shoulder or arm), the clavicular and acromial portions of deltoideus, as well as the elbow extensors, show significantly higher RSPCA values in red-tailed monkeys. The relative RSPCA of the spinous portion of deltoideus, as well as the elbow flexors, is higher in vervets. For most of the forelimb muscles in vervets, velocity is a priority over force, especially in most shoulder muscles and in the elbow extensors. In red-tailed monkeys, most of these same muscles are better suited for isometric, rather than isotonic, contraction.

These results generally agree with those previously reported for hind-limb muscles, in which muscle architecture is related to terrestrial velocity in vervets, and somewhat more anti-pronograde use of a relatively compliant substrate in red-tailed monkeys. Of interest is that fewer interspecific comparisons are significantly different in the forelimb muscles than in the hind-limb muscles of these hind limb dominated primates.

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Regional cranial stability: constancy of the mid-mandibulo-facial region as defined by foramina determinants. J. Y. ANDERSON, University of New Mexico; Washington University, St. Louis.

The midfacial region bounded by the supraorbital, infraorbital, and mental foramina is shown to exhibit relative stability across multiple modern populations. The region of the face is exclusive of areas of masticatory force production, and consistently loads in multivariate space with other nonmechanical regions of skull and mandible.

Linear measurements of the cranium in six modern human populations (Greenland Eskimos, sub-Saharan Africans, North American Amerindians, European-derived Americans, Lapps, Medieval Norwegians) were derived from direct measurement and/or published data. Cranial (bizygomatic breadth; greatest cranial breadth; porion-nasion), and mandibular (coronoid height; corpus depth at lingual tuberosity; minimum ramus breadth) measurements were size corrected using the geometric mean technique. Results from canonical variate, factor, and principle component analyses consistently showed the foramina area loading with measures of the cranium not influenced by masticatory musculature (corpus depth, ramus breadth,

porion-nasion). This suggests a pattern in which the skull *in toto* reflects cranial integration as the primary operant factor, subsuming mechanical force production factors. Secondary to this is a pattern of integration within the mandible itself, and also within the remainder of the cranium. The foraminal area itself is hypothesized to represent a developmental constraint across populations as a result of canalization of cranial nerve (V) innervation patterns in ontogeny. The role of innervation pattern as an antecedent structure predictive of cranial integration through evolutionary constraint is examined.

Cutmarks and drillholes: a study of the cultural modification of human remains from central California. V.A. ANDRUSHKO, D.L. GRADY, K.A. LATHAM, and A. PASTRON, Archeo-Tec, Oakland, California 94618.

The study of cultural modifications to human bone can inform on many aspects of prehistoric life including ideology, worldview, warfare, and social structure. Modified human skeletal elements from a prehistoric site in central California, CA-SCL-674, represent a complex pattern of trauma and ritual previously unknown in this region. We discovered isolated forearm elements with a specific pattern of cultural modification, including drill holes, cutmarks, and polish. Additionally, individuals recovered from the same burial ground exhibit evidence of perimortem trauma and dismemberment of the arms at the distal humerus.

A total of six polished forearm bones were observed with drillholes perforating either the proximal or distal epiphyses. Additionally, two polished forearm bone fragments were recovered. Cutmarks were observed on all six drilled elements.

We believe that the drillholes, cutmarks, and polish on these human skeletal elements, combined with the pattern of cutmarks observed on some burials at CA-SCL-674, represent a pattern of forearm trophy-taking previously undocumented for central California.

By combining ethnographic analogy, zooarchaeology, and SEM cutmark analysis, we will discuss the results of a detailed examination of the pattern of trauma observed and offer an informed interpretation of ancient Native Californian lifeways.

A new Clarkforkian primate fauna from the Great Divide Basin, SW Wyoming. R.L. ANEMONE, E.M. JOHNSON, Department of Anthropology, Western Michigan University, Kalamazoo, MI 49008; B.A. NACHMAN, Department of Anthropology, Washington University, St. Louis, MO 63130; and D.J. OVER, Department of Geological Sciences, SUNY at Geneseo, NY 14454.

Six field seasons of geological and paleontological investigations in early Tertiary sediments of the Great Divide Basin have yielded a small but diverse Clarkforkian mammalian fauna. Comprised of approximately 200 individual skeletal specimens, this fauna comes from fluvial green mudstones and paleosols of the Fort Union formation in the Twelve Mile Well quadrangle of Sweetwater County, Wyoming. The lithologies and the fauna both strongly suggest a warm and humid lakeshore environment during this time period (latest Paleocene or earliest Eocene) in southern Wyoming. Taxonomically, the Twelve Mile Well fauna is dominated by archaic primates and condylarths. While most taxa are represented by isolated teeth and partial jaws, a few, mostly taxonomically unidentified postcranial specimens have also been recovered through a combination of detailed surface collecting and quarrying with dry and wet screen washing.

Plesiadapoid primates are represented by two species of *Plesiadapis* (*P. cookei* and *P. dubius*), the coexistence of which strongly suggests that this assemblage dates to the middle Clarkforkian (Cf₂) North American Land Mammal Age. Other plesiadapiforms include *Carpolestes* sp., *Chiromyoides major*, and *Phenacocemur* sp. All are found during Cf₂ time at other localities in Wyoming and Montana. The rest of the fauna includes typical Clarkforkian forms classified within the orders Rodentia, Insectivora and Condylarthra, as well as a typical lower vertebrate fauna (e.g., fish, lizards, turtles, and champsosaurs).

Faunal comparisons have been made with Clarkforkian faunas from other localities in both southern (Big Multi Quarry, Buckman Hollow) and northern Wyoming (Paint Creek and Sand Coulee) in an attempt to more precisely place the Twelve Mile Well fauna in a chronometric framework. Species level comparisons of plesiadapiform, condylarth, and other mammalian taxa confirm placement of this fauna in Cf₂ times, slightly younger than the nearby Big Multi locality. We thank the Wyoming BLM for their support.

Paleoindian remains from Warm Mineral Springs (8So19), Florida. S.C. ANTÓN, J.F. POWELL, and R.L. QUINN. University of Florida, Gainesville, 32611 and University of New Mexico, Albuquerque, 87131.

Among the late Pleistocene archaeological sites of North America are a number of submerged sites in Florida, including the purportedly early Warm Mineral Springs Site (WMS) of Sarasota County. Excavated during the 1950's through 1970's the human skeletal

assemblage from WMS is amongst the largest of the early sites in North America but has never been systematically analyzed. Based on reported ^{14}C dates of between 10,000 and 10,600 b.p. on charcoal and the site's distance from the Bering land bridge, the WMS remains are of significance to both the timing and mode of colonization of the New World.

We compare cranial and postcranial remains from WMS (NISP = 19) with other New World samples. Adult and subadult cranial ages are assessed using standard techniques including dental and sutural development. In addition to mandibular, dental and cranial thickness metrics, Howell's measurements were taken on the adult WMS crania ($n=3$). We compare these with other North American paleoindian remains ($n=10$) and with Hanihara (1997) and Howell's (1971, 1973) worldwide datasets via multivariate techniques. Standard postcranial metrics and stature predictions are compared with those from pre-contact North Americans, other Hunter-Gatherers, and recent humans.

The WMS remains represent minimally six individuals: three adults, two male and one female, and three juveniles aged ~18 months, 2-3 years, and 6-10 years. Based on our reconstructions of recoveries at the site, these represent four of the seven complete crania from WMS but only a small number of the postcranial remains. The multivariate analysis finds the adult skulls to be most similar to other North American Paleoindian remains, and just outside the range of variation seen in modern American Indian, but not East Asian samples. Postcranial remains predict statures of 159 to 172 cm depending upon the formula used. Sexual dimorphism is moderate to substantial with females being 75 to 90% of male size based on length and breadth measurements.

The Fit of the Preece-Baines model I to statural data of Basque males from the city of Bilbao (Basque Country). A.G. APRAIZ. University of Kansas, Lawrence.

Many structural models are used to characterize growth processes of individuals as well as in populations. These models effect different periods of growth: infancy and childhood, adolescence, from infancy to adulthood. The Preece-Baines model is based on the infancy to adulthood period. Constants are non-linear for the majority of the structural models. The sample is composed of 1,000 Basque males from the city of Bilbao, of ages ranging from 5 to 19 years, measured cross-sectionally. Sampling took place between November 1992 and May 1994. Stature was measured following the procedures of the IBP (Eveleth and Tanner 1991). Fit of Preece-Baines statural curve has been performed through a non-linear regression method. Iterations respond to the method of Levenberg-Marquardt given by NLR procedure of SPSS statistical package for a VAX/VMS computer. The model has been fitted to individual raw data. Residual mean squares (RMS) and

standard deviation (SEE) values are also provided. Results provide values of both model and derived biological parameters. Maximum adult size has been of 175.48 cm. Among all derived biological parameters, age at growth spurt takes place at 12.85 years. Distance and pseudovelocity curves are provided as well. In addition, age at growth spurt from Bilbao males has been compared to those of other populations worldwide, observing that Japanese and Basque males show the earliest ages at growth spurt of all populations considered. In fact, Japanese show the earliest age at growth spurt (12.60 years) of all the studied populations.

Huddling behavior in bearded saki monkeys (*Chiropotes satanas chiropotes*) of Bolivar State, Venezuela.

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A multi-female, multi-male social group of bearded saki monkeys (3 adult males, 3 adult females, and 4 juveniles of undetermined sex) was studied on an island in Guri Lake, Bolivar State, Venezuela to examine the context of a distinctive behavior, huddling. Huddling is defined as two or more individuals embracing or crowding close together usually on a horizontal substrate which can support their combined body weight. Huddling bouts may be accompanied by alarm or chirping vocalizations and/or tail-wagging and last for an average of 23 seconds. Preliminary observations suggest that huddling might be associated with resource defense, mate defense and predation avoidance. Ad libitum and scan sample data collected by Araya (unpubl.) and by Peetz (1997) on huddling behavior of a social group of 10 bearded sakis reveal age and sex-specific patterns of group member interactions. Behavioral samples of huddling show that there is a preference of certain individuals to maintain close proximity with one another particularly in times of stress or disturbance caused by the presence of a predator or other threat such as a traveling group of capuchins (*Cebus olivaceus*). Huddling occurred more often between males (62%) than between males and females (38%) or solely between females (0%). Juveniles were included in huddles 16% of the time and usually because of their association with an adult female. These observations suggest that huddling in bearded sakis is usually a response to threatening situations. These data represent the first evidence for male-male affiliative interactions in a poorly known New World primate.

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Women in ancient Nubia: Birth, babies, beer and bread. G.J. ARMELAGOS, Emory University, Atlanta, GA. L. SILBEY, American College of Nurse-midwives. D.L. MARTIN, Hampshire College, Amherst, MA.

The intensification of agriculture increased nutritional and infectious disease stress that is differentially borne by women and children. Reduced birth spacing and lactation is the primary stressor. Ancient Sudanese Nubian from Wadi Halfa experienced stressors that systematically challenged biological well being. Women during their peak reproductive period experienced problems with cortical bone mineralization, losses in percent of trabecular bone and decrease in bone density (ash weight). The growth of infants and children experienced decelerated growth and less than optimal cortical bone development. At Kulubnarti, pelvic dimensions of female were affected by nutritional stressors that have implication for mothers during birth and their neonates.

These changes must be viewed from the backdrop of tetracycline ingestion. Tetracycline produced through the process that links bread baking and beer brewing had positive and negative consequences. Non-antibiotic property tetracycline inhibits osteoclastic activity and provided Nubians some protection against bone loss. There is an association of tetracycline use and an increase in anemia measured by porotic hyperostosis. This may be related to alcohol ingestion that was the delivery system for the tetracycline. This is of particular interest since fermented cereal gruel was an important weaning food.

HLA in the Azores Archipelago: the presence of Mongoloid genes. A. ARNAIZ-VILLENA, J. BRUGES-ARMAS¹, L. ALLENDE and J. MARTINEZ-LASO. Immunology and Mol. Biology, H. 12 de Octubre, 28041 Madrid, Spain. e-mail: antonio.arnaz@inm.h12o.es. ¹Medicine, Terceira, Azores, Portugal.

The HLA profile of the Azoreans has been compared with those of other world populations in order to provide additional information regarding the history of their origins. The allele frequencies, genetic distances between populations, correspondence analyses and most frequent haplotypes were calculated. Our results indicate that the Azorean population contains an admixture of high frequency Caucasoid, Mongoloid and, to a lesser degree, Negroid HLA genes. The middle Atlantic Azores Archipelago was officially colonized by the Portuguese after 1439 and historical records are concordant with the existence of Caucasoid and Negroid population. However, Mongoloid genes were not suspected, but the Oriental HLA haplotypes A24-B44-DR6-DQ1, A29-B21-DR7-DQ2 and A2-B50-

DR7-DQ2 are the fourth, fifth and sixth most frequent ones in Azores. A correspondence analysis shows that the Azorean population is equidistant from Asian and European populations and genetic distances are in some cases closer to the Asian than to European ethnic groups, and never are significantly different; also, B*2707 subtype is found in Asians and Azoreans (but not in Europeans) and the same Machado-Joseph Disease founder haplotypes (Chr 14) are found in both Japanese and Azoreans. It is proposed that a prediscovering Mongoloid population exists in Azores.

Development of palatal shape in *Pan troglodytes*, hominids and *Homo sapiens*. W.H. ARNOLD, A. ZOELLNER and TH. SEBASTIAN, Dept. of Anatomy, University of Witten/Herdecke, Germany

Palatal shape is crucial for the development of speech. It was therefore the aim of this study to compare the palatal shapes of *Pan troglodytes* with that of *Homo sapiens* and various fossil hominids. The following specimens were analyzed: 99 palates of *Pan troglodytes* (8 infantile, 30 juvenile, 61 adults; The Cleveland Museum of Natural History (CMNH)), 2 palates of *Australopithecus afarensis* (AL 200, AL 333; CMNH), 3 palates of *Australopithecus africanus* (STS 52, STS 71, Child of Taung; CMNH), 4 palates of *Australopithecus robustus* (SK 12, SK 13, SK 46, SKW 11; CMNH) 1 palate of *Australopithecus boisei* (Musée de l'Homme, Paris), 2 palates of *Homo erectus* (Musée de l'Homme, Paris) 3 palates of *Homo neanderthalensis* (La Chapelle, Qafzeh, La Ferrassie; Musée de l'Homme, Paris) and 78 palates of *Homo sapiens* (13 infantile, 16 juvenile, 49 adult; various collections). Three-dimensional coordinates of landmarks of the hard palate were determined using an instrument described by Arnold (1994), and these coordinates were used for three-dimensional reconstruction of palatal shapes using the "Auto CAD" computer program.

The palate of *Pan troglodytes* developed from a rather flat, short shape in infantile specimens (2.74 cm \pm 0.17 cm length; 1.13 cm \pm 0.39 cm posterior height) towards a longer, narrower shape in adults (6.5 cm \pm 0.91 cm length, 1.84 cm \pm 0.3 cm posterior height). In *Homo sapiens* the palatal shape did not change much from juvenile specimens to adult specimens, only a steady growth could be determined. The palatal length increased from 2.89 cm \pm 0.97 cm to 4.65 cm \pm 0.25 cm. Posterior palatal height increased from 0.3 cm \pm 0.21 cm in infants to 1.35 cm \pm 0.29 cm in adults. The palatal shapes of all investigated Australopithecine specimens resembled that of *Pan troglodytes*, whereas the palatal shapes of the Neanderthal specimens were more similar to those of adult *Homo sapiens*. The palatal shape of *Homo erectus* was in between *Pan troglodytes* and *Homo sapiens*.

Based on palatal shape, we conclude that the Australopithecines were not capable of speech, whereas the Neanderthals may well have been able to produce speech.

Preliminary observations of positional behavior and support use in *Alouatta palliata* at Bocas del Toro, Panama, with comparison to *A. seniculus* at French Guiana. G. P. ARONSEN, Department of Anthropology, Yale University. Box 208277, New Haven, CT 06520.

I present results on a one-month field study of positional behavior and support use by mantled howler monkeys (*Alouatta palliata*) at Bocas Del Toro, Panama, and compare these to data on red howlers (*Alouatta seniculus*) at the Station des Nouragues in French Guiana. Because Bocas del Toro contains heavily disturbed secondary marsh forests and the Station des Nouragues contains primary rain forest, the data address questions about interspecific plasticity in positional behavior in *Alouatta* as well as investigating the possibility of sex differences in mantled howlers.

I saw few sex differences in *A. palliata*, and all correlate with sexual dimorphism. Females used smaller branches and more diverse feeding and locomotor repertoires, such as bipedal standing and leaping, while males were more limited in support use and positional behaviors (e.g., they used larger branches and engaged in more quadrupedal standing and suspensory locomotion than females).

Comparisons with *A. seniculus* show a high degree of concordance between species, even though the habitats are dramatically different. The most striking differences in *A. palliata* were in the amount of tail-only hanging during feeding, a higher frequency of climbing and suspensory locomotor behaviors, and increased use of emergent and lower canopy layers. This variation in *A. palliata* reflects the use of emergent species for feeding during the observation period and forest discontinuity at Bocas del Toro. These preliminary results suggest that there is a great deal of stability in *Alouatta* positional behavior and support use across habitats, and speak to the current debate regarding the flexibility or canalization of these variables in primates.

This research was funded through the Williams Fund of the Yale Department of Anthropology.

New research in the Kibish Formation, southern Ethiopia. Z. ASSEFA, Doctoral Program in Anthropological Sciences, SUNY at Stony Brook, Stony Brook, NY 11794, F. BROWN and B. PASSEY, College of Mines and Earth Sciences, University of Utah, Salt Lake City, UT 84112, J.G. FLEAGLE, Department of Anatomical Sciences, SUNY at Stony Brook, Stony Brook, NY 11794-8081, and S. YIRGA, Department of Biology, Addis Ababa University, Addis Ababa, Ethiopia.

During a 1967 expedition led by R.E.F. Leakey, the Omo Kibish Formation of southern Ethiopia yielded hominid remains that have been widely recognized as among the earliest anatomically modern humans. However, the

absolute ages of the Kibish remains have never been clearly resolved.

In January and February, 1999 we conducted geological, paleontological and archeological surveys of the Kibish Formation in order to evaluate the prospects for additional longterm field work in that area aimed at documenting the paleontological and archeological sequence and resolving questions about the age of the deposits.

Vertebrate fossils were widespread throughout the formation as were Middle Stone Age artifacts. We recovered remains of carnivores, proboscideans, equids, giraffids, hippopotamids, several genera of bovids, and one hominid. At several sites, the faunal remains showed cutmarks and other evidence of human activity.

Several materials were collected for dating, including volcanic tephra, mollusc shells, tooth fragments, and fossil wood. It is apparent from preliminary geochemical analyses of tephra that the stratigraphy of the Kibish Formation is more complicated than formerly believed. In the type area there appear to be two distinct sets of deposits, one East of the Omo River and another West of the River.

This work was funded by the NSF, the Wenner-Gren Foundation, the LSB Leakey Foundation, and the National Geographic Society.

Greater female tibial growth in high altitude Tibetan children. S.M.BAILEY, Tufts Univ, Medford, MA 02155, and X.M.HU, S. China Normal Univ, Guangzhou 510631.

Reduction in sexual dimorphism at the expense of males is well known. By contrast, we have shown female growth reduction among Tibetans and Han at 3000 m in Sichuan, China. The present data, for 16 girls and 15 boys aged 10-13 years living at 4200m in northeastern Tibet, were analyzed for evidence of altered sexual dimorphism in response to hypoxia.

Compared to the 3000m site, both boys and girls were smaller, by about 1 cm in height, and boys were 1.2 kg lighter. Despite greater hypoxic stress, chest circumference and lung volume, corrected for height, were .4 cm and 313 cc smaller in the higher altitude girls and 2.0 cm and 47 cc smaller in the boys. Chest to height ratios were reduced in the higher site's boys, but similar for the girls.

Sexual dimorphism at the highest site was little affected for height, with girls remaining about 2% taller, but they were 11% heavier, compared to a 4% at 3100m, and had 13% larger upper arms. Boys had 24% larger lungs, compared to a 8% difference at 3000m.

Growth of the lower leg may be a particularly sensitive indicator of environmental stress. Using ratios of calf to thigh and forearm to upper arm lengths, we found that at 4200 m, Tibetan girls, but not boys, showed significant positive correlations (0.65) of lower limb ratio to lung volume, but not to chest circumference or body size. This association held after partialling BMI, skinfold thickness, and height. Arm segments showed no such associations.

Girls with relatively longer tibia thus had greater lung volume and more body fatness. A nonlinear power function best fit the leg and lung data, while a log function best fit the fat and lung variables.

These results suggest that Tibetan boys undergo more severe physiological stress than do girls, despite their disproportionately larger lungs. Growth indicators of stress appear linked to pulmonary function. Differences between these findings and those for Chinese Tibetans may reflect both cultural and physiological factors.

Mitochondrial DNA analysis of Choctaw and Menomonee hair shafts from the Boas collection.

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Recent studies using ancient DNA have focused on the analysis of mitochondrial DNA (mtDNA). mtDNA is theoretically well suited for the analysis of short-term evolutionary phenomena due to its pattern of maternal inheritance, high copy number and increased mutation rate. Advances in bio-molecular technology now provide tools that allow for the extraction and analysis of DNA from archaeological samples including hair shafts.

In 1893, the World's Colombian Exposition prompted the documentation and collection of anthropomorphic data on over 15,000 Native Americans under the supervision of Franz Boas. Hair samples were also collected from a subset of these individuals and are now stored at the American Museum of Natural History in New York. The collection includes roughly 2482 hair shaft samples representing over 86 different tribes.

Using a computerized database housed at the University of Tennessee, Knoxville that contains the anthropomorphic and pedigree data of the collection, a subset of the hair samples was chosen for a study of mtDNA haplotypes. Twenty-five samples from each of two tribes, the Choctaw of Mississippi and the Menomonee of Wisconsin, were chosen. Individuals were included only if their mothers were listed as "full blood." The first hypervariable section of the displacement loop of mitochondrial DNA (mtDNA) was sequenced for the 50 samples. On the basis of the mtDNA results, the genetic differences between these two geographically separated tribes are discussed and are compared to both contemporary and ancient groups reported in the literature.

Molecular evidence for relationships among branchial arch derivatives: Implications for reconstruction of the upper respiratory tract in fossil hominids.

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Positional relationships of the upper respiratory tract are important parameters that determine how an animal breathes, swallows, and vocalizes. Reconstruction of this region in fossil hominids is therefore of considerable importance in attempts to understand their physiological behaviors. While a number of studies have used craniometric and biomechanical relationships to reconstruct the region, the absence of basic biological information on the underlying genetic template has precluded such data from being employed. This study utilizes molecular biological techniques (e.g., RNA *in situ* hybridization and subtractive hybridization) to investigate relationships between the rostral and caudal branchial arches and their contributions to the development of the upper respiratory tract. Work by us and others have established that specific proteins, including Ephrin B2, a contact dependent signaling molecule, show restricted patterns of expression in the hindbrain and branchial arches during neural crest cell migration. RNA *in situ* hybridization of post-gastrulation mouse and chicken embryos have identified Ephrin B2 at increased concentrations in the rostral arches thus establishing genetic differences among the branchial arches. These preliminary results suggest that derivatives of specific branchial arches may well be tightly linked together while those from different arches may not be under the same developmental cues. Knowledge of the degree of genetic interdependence of such aerodigestive structures will, in turn, enable another dimension to be used in reconstruction of the region in fossil hominids. The potency of new molecular approaches may offer diagnostic clues to interpreting this region so pivotal in our evolution.

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Genetic evidence on the origins of Indian caste populations
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Shared Indo-European languages (i.e., Hindi and most European languages) suggested to linguists that

contemporary Indians are descendants of Caucasians who migrated from Western Eurasia (Europe, the Near East, Anatolia, and the Caucasus) 3,000 to 8,000 years ago. These nomadic migrants purportedly consolidated their power by admixing with native Dravidic-speaking populations who controlled regional access to land, labor, and resources and established the Hindu caste hierarchy to legitimize and maintain this power. However, archaeological evidence of the diffusion of material culture from Western Eurasia into India has been limited. Thus, this model of the origin of Indian caste populations is, at best, speculative. One alternative model is that Indians are descendants of proto-Asians who, with only limited West Eurasian admixture, developed a sophisticated social structure that underlies the contemporary caste system.

To reconcile the origin of Indian castes, we used mtDNA, Y chromosome, and autosomal markers to estimate the genetic affinities of castes of varied status to world-wide populations. For maternally inherited mtDNA, the majority of Indian mtDNA lineages belong to an Indian-specific Asian haplogroup, and all castes show highest similarity with East Asians. In contrast, for paternally inherited Y chromosomal variation, the upper castes exhibit greatest similarity with Europeans, while other caste groups exhibit greatest similarity with East Asians. For biparentally inherited autosomal markers, all castes exhibit greatest similarity with Europeans with a trend toward upper castes displaying more similarity to Europeans than lower castes. We conclude that Indians are largely of proto-Asian origin, and admixture with West Eurasians was recent and limited in scope. Nevertheless this admixture resulted in rank-related and sex-specific differences in the genetic affinities of castes to East Asians and Europeans.

Cultural modifications to human and faunal cremated bone: The role of fauna in Northeastern Late Archaic cremation features. By L. BARBIAN, National Museum of Health and Medicine, Armed Forces Institute of Pathology

Cremation is the preferred, if not exclusive, form of interment observed in the Susquehanna mortuary tradition of the Northeast United States. The osseous material recovered from the Turner Farm site represents one of the largest collections of Late Archaic human and faunal remains recovered from the Northeast. The cremation features from Turner Farm attest to a pattern of mortuary behavior characterized by a substantial degree of cultural investment in the burial program. Analysis of the human remains suggests cultural modification of the remains prior to incineration and deposition. Burning patterns suggest that individuals were not articulated and were in various stages of decomposition: no complete individuals were deposited in the cremation features. Faunal remains recovered from the cremation features include unburned and smoked bone; a majority of the faunal material is calcined. Species present in the assemblage include deer, bird, fox, seal, dog, moose, and fish. While inclusion of faunal bone in cremations of the Susquehanna tradition has long been noted, the mass of

burned faunal bone associated with the Turner Farm cremations appears to be far greater than that reported for other sites. The midden context of the burial features and the presence of burned and unburned faunal material in the fill of some unburned interment features suggest that all of the faunal material may not be directly related to the cremation event. Recently, researchers have compared faunal assemblages and human skeletal remains to elucidate cultural or taphonomic processes responsible for their inclusion in the archaeological record. This study compares the burning patterns of human and faunal cremated bone at Turner Farm to determine if the faunal bone was burned and culturally modified in a manner similar to that seen in the human remains, thus representing a component of the mortuary event.

Aspects of the European prehistory, inferred from nuclear and mitochondrial DNA diversity. G. BARBUJANI and L. SIMONI, Dept. Biology, Universities of Ferrara and Bologna, Italy.

Allele-frequency patterns in Europe are traditionally regarded as reflecting a Neolithic population dispersal from the Levant, but mtDNA genealogies have been interpreted as evidence for a largely Mesolithic, local origin of the European gene pool. In principle, clines encompassing much of the continent may be due either to the initial, Paleolithic colonization, or to a large-scale population replacement at the Neolithic. Conversely, if Mesolithic reexpansions from glacial refugia had a major impact on the current patterns of genetic diversity, most DNA alleles should not be clinally distributed.

Spatial autocorrelation analysis (SAAP and AIDA) of 14 autosomic and Y-chromosome polymorphisms (including 10 microsatellite and 2 minisatellite loci), in Europe shows broad gradients encompassing much of the continent for virtually all markers studied. MtDNA sequence variation, by comparison, is poorly structured, with only Saami clearly differentiated from all other groups. However, a clinal structure is apparent when Southern European samples are separately analyzed.

Under a model of population expansion by successive fissions, estimates of the times since separation can be obtained from STR diversity. These estimates are affected by local gene flow reducing interpopulation diversity; however, even when allowing for that, the gene pools of distant groups speaking Indo-European languages appear to have separated less than 10,000 years ago. Recent separation times are compatible both with Mesolithic expansions from glacial refugia, and with a Neolithic demic diffusion from the Levant. But the broad genetic gradients observed are compatible only with a directional process affecting much of the continent, i.e. only with the latter (or with founder effects during the early Paleolithic colonization, which, however, should also result in ancient population differentiation). Accordingly, a large fraction of the European gene pool seems derived from ancestors who entered Europe only in Neolithic times.